# Water Quality Assessment and TMDLs for the Flathead River Headwaters Planning Area, Montana

## *Summary Report*

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# 1.0 Introduction

In 2003, the U.S. Environmental Protection Agency (EPA), Montana Department of Environmental Quality (MDEQ), and Flathead National Forest (FNF) began to address the stream segments in the Flathead River Headwaters Total Maximum Daily Load (TMDL) Planning Area (TPA) that have been placed on Montana's list of impaired waters, which is prepared in accordance with Section 303(d) of the Clean Water Act (and referred to as the "303(d) list"). Twelve stream segments and one reservoir in the planning area appeared on Montana's 303(d) list (Table 1, Figure 1). The causes of impairment include flow alteration, other habitat alterations, nutrients, suspended solids, and siltation (MDEQ, 1996). MDEQ revised the 303(d) list in 2002 using a new procedure. The 2002 303(d) listings are also shown in Table 1. Challenge Creek and Hungry Horse Reservoir were removed from the 303(d) list in 2002 on the basis of the revised listing procedure.

All available data were analyzed to verify the 303(d) listed beneficial use impairments. Updated conclusions were reached regarding current water quality impairment status for each of these water bodies, and TMDLs establishing the maximum amount of pollutants that a water body can receive and still meet water quality standards were prepared for those waters not currently meeting Montana's water quality standards. MDEQ published this information in a report entitled *Water Quality Assessment and TMDLs for the Flathead River Headwaters Planning Area, Montana* (referred to as the "full report"). This summary report has been prepared as a companion document to the full report, and is intended to provide an overview of the information and conclusions reached for the Flathead River Headwaters TPA.

The remainder of this summary report follows the same organizational format as the full report. The relevant environmental and socioeconomic characteristics of the TPA are summarized in the Section 2.0, Watershed Characterization. The current water quality impairment status for each of the 303(d) listed waters is presented in Section 3.0, Water Quality Impairment Status. All of the required TMDL elements for Coal Creek, the only water body within the TPA that is currently impaired, are presented in Section 4.0, Total Maximum Daily Load. A summary of the proposed monitoring and restoration strategy is presented in Section 5.0, Monitoring and Restoration Strategy, and conclusions are presented in Section 6.0.

**Table 1. Summary of the 303(d) Listings for Waters in the Flathead River Headwaters TPA**

| Watershed | Segment Name and ID | Use Class | Year Listed | Probable Causes |
|---|---|---|---|---|
| North Fork Flathead River | **Big Creek** MT76LJ003-050 | B1 | 1996 | Habitat alterations/siltation |
| | | | 2002 | TMDL completed |
| | **Red Meadow Creek** MT76Q002-020 | B1 | 1996 | Habitat alterations/siltation |
| | | | 2002 | Habitat alterations/siltation |
| | **Whale Creek** MT76Q002-030 | B1 | 1996 | Habitat alterations/siltation |
| | | | 2002 | Habitat alterations/siltation |
| | **South Fork Coal Creek** MT76Q002-040 | B1 | 1996 | Habitat alterations/siltation |
| | | | 2002 | Habitat alterations/siltation |
| | **Lower Coal Creek** MT76Q002-080 | B1 | 1996 | Siltation |
| | | | 2002 | Siltation |
| | **North Fork Coal Creek** MT76Q002-070 | B1 | 1996 | Nutrients/siltation |
| | | | 2002 | Siltation |
| Middle Fork Flathead River | **Granite Creek** MT76I002-010 | B1 | 1996 | Habitat alterations/ siltation/suspended solids |
| | | | 2002 | Siltation/bank erosion |
| | **Skyland Creek** MT76I002-020 | B1 | 1996 | Habitat alterations/ siltation/suspended solids |
| | | | 2002 | Insufficient credible data |
| | **Morrison Creek** MT76I002-050 | B1 | 1996 | Habitat alterations/siltation |
| | | | 2002 | Habitat alterations/siltation |
| | **Challenge Creek** MT76I002-040 | B1 | 1996 | Habitat alterations/siltation |
| | | | 2002 | Not listed |
| South Fork Flathead River | **South Fork Flathead River** MT76J001-010 | B1 | 1996 | Habitat alterations<br>Flow alterations |
| | | | 2002 | Flow alterations |
| | **Sullivan Creek** MT76J003-010 | B1 | 1996 | Habitat alterations |
| | | | 2002 | Insufficient credible data |
| | **Hungry Horse Reservoir** MT76J002-1 | B1 | 1996 | Flow alterations<br>Siltation<br>Suspended solids |
| | | | 2002 | Not listed |

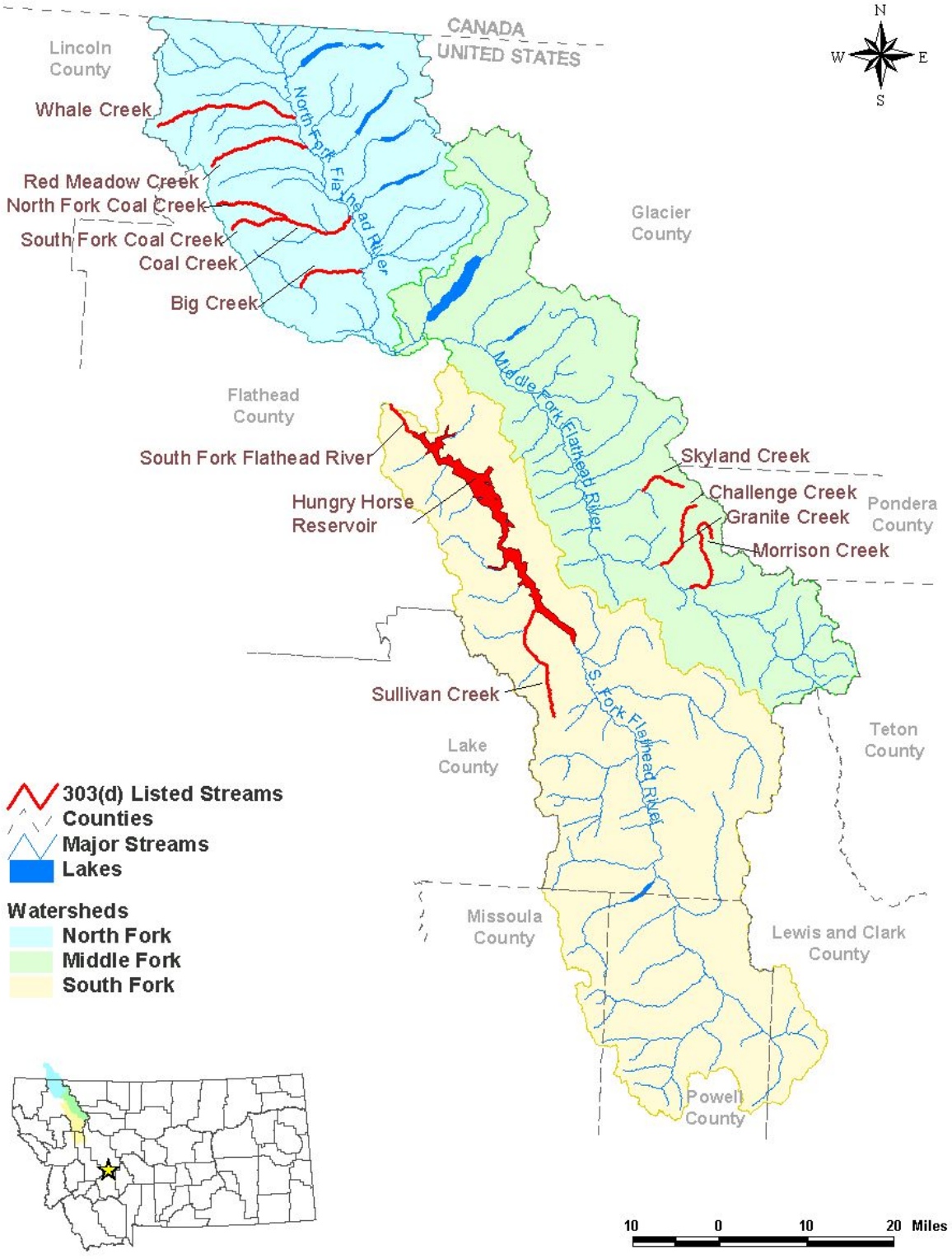



**Figure 1. Location of the Flathead River Headwaters TPA and 303(d)-listed streams.**

# 2.0 Watershed Characterization

The Flathead River Headwaters TPA is located in northwest Montana, and it encompasses an area of nearly 4,370 square miles in the United States and Canada (see Figure 1). There are three major rivers located in the TPA – the North, Middle, and South Forks of the Flathead River. These three rivers eventually join together to form the Flathead River, which ultimately flows into Flathead Lake. Elevations range from more than 10,000 feet in the mountainous regions to approximately 3,000 feet in the Flathead Valley. A large portion of the watershed is federally owned and contains Glacier National Park, the Flathead National Forest, the Bob Marshall Wilderness, and the Great Bear Wilderness.

**Middle Fork Flathead River near West Glacier, Montana**

A number of factors that can influence water quality within a watershed were assessed as part of the watershed characterization. These factors included climate, hydrology, topography, geology, soils, and precipitation. The information was compiled from a variety of readily available sources, such as weather stations, the U.S. Geological Survey's National Water Information System (NWIS), the Natural Resources Conservation Service, FNF reports, and other published technical reports. Additional characteristics that might play a significant role in driving pollutant loadings (for example, forest harvest, vegetative cover, fire history) were also assessed.

**North Fork Flathead River near Polebridge, Montana**

The biology of the Flathead River Headwaters is complex. Westslope cutthroat trout, bull trout, and mountain whitefish are the native game species found in the region. Montana Fish, Wildlife, and Parks (MFWP) has designated a number of waters in the planning area as "core/priority" bull trout streams. It is believed that bull trout populations have declined in recent years in part due to alterations in the trophic dynamics in Flathead Lake (introduction of mysis shrimp and resulting food chain effects) (Spencer et al., 1991). Bull trout are currently on the federal list of threatened species (species that are likely to become an endangered species within the foreseeable future throughout all or a significant portion of their range).

# 3.0 Water Quality Impairment Status

The 1996 303(d) list reported that the following water bodies in the planning area were impaired: Red Meadow Creek, Whale Creek, Big Creek, Coal Creek, South Fork Coal Creek, North Fork Coal Creek, Granite Creek, Skyland Creek, Challenge Creek, Morrison Creek, South Fork Flathead River, Sullivan Creek, and Hungry Horse Reservoir (see Figure 1 and Table 1). The listed causes of impairment for these water bodies included habitat alteration, flow alteration, bank erosion, nutrients, siltation, and suspended solids.

Habitat alternation, flow alteration, and bank erosion are considered "pollution," while siltation, suspended solids, and nutrients are considered "pollutants." It is EPA's position that TMDLs are required only for "pollutants" that are causing or contributing to water body impairments (Dodson, 2001). Therefore, because TMDLs are required only for pollutants and because flow alternation, habitat alteration, and bank erosion are not pollutants, the focus of this document is on siltation, suspended solids, and nutrients. Flow alteration, habitat alteration, and bank erosion might certainly constitute potential sources or causes of sediment-related impairments. Although no TMDLs have been established to specifically address these issues, they will be addressed as sources, as appropriate.

The sections that follow present the water quality standards that apply to the 303(d)-listed pollutants (Section 3.1), the indicators used to measure impairment (Section 3.2), and the updated determinations of beneficial use impairment (Section 3.3). For water bodies determined to be meeting all beneficial uses, the rationale behind the decision is documented in Section 3.3. No TMDLs are required for these water bodies. Water bodies that are found to have impaired beneficial uses are further discussed in Section 4.0 (Total Maximum Daily Load).

## 3.1 Water Quality Standards

Water quality standards specify the uses designated for a water body (such as growth and propagation of fish and associated aquatic life, drinking water, agriculture, industrial supply, and recreation), the legally enforceable numeric and narrative criteria that ensure that the uses are supported, and a nondegradation policy that protects the high quality of a water body. In the case of sediment and nutrients, no specific numeric criteria have been adopted; rather, the state relies on narrative criteria. In general, the narrative criteria do not allow for harmful or other undesirable conditions to occur above naturally occurring levels of pollutants from discharges to state surface waters. Because narrative criteria do not refer to a specific number indicating the maximum allowable level of a pollutant, it is necessary to translate them into measurable water quality goals. This is interpreted to mean that goals should strive toward a reference condition that reflects a water body's greatest potential for water quality given current and historical land use activities where all reasonable land, soil, and water conservation practices have been applied. A detailed description of the applicable water quality standards can be found in the full report (see Section 3.2).

## 3.2 Water Quality Goals and Indicators

As described above, the water quality standards for nutrients and sediment are narrative. To evaluate compliance with the narrative criteria, they must be converted, or translated, into numeric values. In the Flathead Headwaters TPA, this was facilitated by selecting a suite of targets and supplemental indicators based on literature values and research applicable to northwestern Montana mountain streams. In simple terms, targets are threshold values that, if exceeded, indicate a high likelihood of water quality impairment associated with the pollutant of concern (i.e., water quality impairment is probable). In contrast, supplemental indicators provide only supporting information and are used only in combination

with the full suite of targets and supplemental indicators. The targets and supplemental indicators are used together in a weight-of evidence approach to translate the narrative criteria and valuate compliance with water quality standards. Tables 2 and 3 present the suites of targets and supplemental indicators used in the Flathead River Headwaters TPA for sediment and nutrients, respectively. Refer to the full report for a detailed description of the weight-of-evidence approach.

**Table 2. Summary of the Proposed Sediment Targets and Supplemental Indicators for the Flathead TPA**

| **Targets** | **Threshold** |
|---|---|
| 5-year Mean McNeil Core Percentage of Subsurface Fines < 6.35 mm | 35% |
| 5-year Mean Substrate Score | ≥ 10 |
| Percentage of Surface Fines < 2 mm | < 20% |
| Clinger Richness | ≥ 14 |
| **Supplemental Indicators** | **Recommended Value** |
| Juvenile Bull Trout and Westslope Cutthroat Trout Density | Documented increasing or stable trend |
| Bull Trout Redd Counts | Documented increasing or stable trend |
| Suspended Sediment Concentration Mean<br>Suspended Sediment Concentration Mean Annual Maximum<br>Suspended Sediment Concentration Maximum | 3.2 ± 5.2 mg/L<br>14.6 mg/L<br>61.6 mg/L |
| Turbidity | High flow – 50 NTU instantaneous maximum<br>Summer base flow – 10 NTU |
| Pfankuch Mass Wasting Score | “good” |
| Pfankuch Bank Vegetation Score | “good” |
| Pfankuch Cutting Score | “good” |
| Pfankuch Deposition Score | “good” |
| Montana Mountain Macroinvertebrate Index of Biological Integrity | > 75% |
| Percentage of Clinger Taxa | “high” |
| EPT Richness | ≥ 22 |
| Periphyton Siltation Index | < 20 |
| Fire | Evaluated on a case-by-case basis |
| Equivalent Clear-Cut Acres | < 25% |
| Water Yield | < 10% |
| Roads | Evaluated on a case-by-case basis |

Notes: mm = millimeters; mg/L = milligrams per liter; NTU = nephelometric turbidity unit.

**Table 3. Summary of the Proposed Nutrient Targets and Supplemental Indicators for the Flathead TPA**

| Targets | Threshold |
|---|---|
| Benthic Chlorophyll-*a* (Median) | < 33 mg/$m^2$ |
| EPA Ecoregion II, Total Phosphorus (Median) | < 0.01 mg/L |
| EPA Ecoregion II, Total Kjeldahl Nitrogen (Median) | < 0.05 mg/L |
| EPA Ecoregion II, Nitrate+Nitrite ($NO_2$/$NO_3$) (Median) | < 0.014 mg/L |
| EPA Ecoregion II, Total Nitrogen (Median) | < 0.12 mg/L |
| **Supplemental Indicators** | **Recommended Value** |
| Macroinvertebrate Hilsenhoff Biotic Index (HBI) | < 3.5 |
| Montana Mountain Macroinvertebrate Index of Biological Integrity | > 75% |
| Dissolved Oxygen, 7-Day Mean | > 9.5 mg/L |
| Dissolved Oxygen, 1-Day Minimum | > 8.0 mg/L |
| EPA Ecoregion II, Chlorophyll-*a*, Water Column (Median) | < 1.08 µg/L |
| Fire | Evaluated on a case-by-case basis |
| Equivalent Clear-Cut Acres | < 25% |
| Water Yield | < 10% |

Notes: mg/m2 = milligrams per square meter; mg/L = milligrams per liter; µg/L = micrograms per liter.

## 3.3 Current Water Quality Impairment Status

This section reviews the available water quality data for each listed water body in the planning area and updates the water quality impairment status determination. The suite of targets and supplemental indicators described in Section 3.2 has been applied to verify each of the water quality impairments listed on the 1996 and 2002 303(d) lists.

### 3.3.1 Big Creek

The cold-water fishery and aquatic life beneficial uses in Big Creek were listed as impaired on the 1996 303(d) list. The FNF and MDEQ completed a Watershed Restoration Plan for Big Creek, including all necessary TMDLs. EPA approved the TMDL for Big Creek on May 9, 2003. For that reason, Big Creek is not discussed further in this report. The full TMDL report for Big Creek can be found on MDEQ's TMDL Web page at http://deq.state.mt.us/wqinfo/TMDL/finalReports.asp.

### 3.3.2 Red Meadow Creek: Siltation

Red Meadow Creek flows approximately 12 miles from its origin at Red Meadow Lake to its confluence with the North Fork Flathead River. The total watershed area covers roughly 30 square miles. The creek's cold-water fishery and aquatic life beneficial uses were listed as impaired by habitat alterations and siltation on both the 1996 and 2002 303(d) lists.

It appears that Red Meadow Creek's beneficial uses are not currently impaired by siltation. The target and supplemental indicator values are met for all parameters except McNeil cores and bull trout populations. Based on the FNF's source assessment survey, there are some actively eroding sediment sources in the Red Meadow Creek watershed; however, no evidence exists of sediment-caused impairment in the macroinvertebrate data. Macroinvertebrate scores indicate that the aquatic life beneficial uses are not impaired, and the high clinger values suggest that there are no water quality impairments associated with sediment. Neither the substrate scores nor the percentage of surface fines suggests sediment impairment. Finally, none of the visual estimates of mass wasting, vegetative bank protection, bank cutting, and lower bank deposition suggest sediment-related water quality impairments.

**Red Meadow Creek**

Although the mean McNeil core value (40.1 percent subsurface fines smaller than 6.35 millimeters) exceeds the target (35 percent), the McNeil cores were collected roughly 14 years ago, soon after a fire that burned 24 percent of the watershed. Therefore, the McNeil core data are not considered valid for making current beneficial use impairment determinations. The decline in bull trout redd counts and juvenile population cannot necessarily be attributed to water quality conditions in Red Meadow Creek because of the possible influences of Flathead Lake on the bull trout population. The fact that juvenile cutthroat populations have not declined over the same period of record suggests that habitat conditions in Red Meadow Creek are good.

### 3.3.3 Whale Creek: Siltation

Whale Creek flows 21 miles from its headwaters to its mouth. The total watershed area covers approximately 78 square miles. The cold-water fishery beneficial use was listed as threatened on the 1996 303(d) list because of habitat alterations and siltation. The basis for the 1996 listing is unknown. Cold-water fishery and aquatic life beneficial uses were listed as impaired on the 2002 303(d) list because of habitat alterations and siltation.

**Whale Creek**

Overall, it appears that siltation is not impairing beneficial uses in Whale Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the percentage of surface fines at two different sites. There is no indication of sediment impairment in the macroinvertebrate data—the number of clinger taxa was high (more than 14) at two sites in Whale Creek. Because none of the targets were exceeded, beneficial uses in Whale Creek are not considered impaired because of sediment or siltation.

The supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present at the upstream site and there was no indication of impairment by any pollutants. An unknown stressor appears to be affecting macroinvertebrates at the downstream site (low Mountain IBI score), most likely due to natural causes (large presence of blackfly larvae, fires, change in geology). Individual metrics suggest that sediment and siltation are not the cause of the impairment. Bull trout redds declined from 1987 to 1997; however, counts have increased every year since 1998. Bull trout densities, while fluctuating, show no overall trend during the same period. Although the turbidity data are old, they do not suggest water quality impairment due to siltation. Data from the Pfankuch surveys indicate little mass wasting and good riparian conditions, with some sediment deposition and bank cutting observed. Potential sediment sources exist throughout the watershed (fire, clear-cuts, roads); however, the equivalent clear-cut acreage (ECA) indicator was not exceeded.

### 3.3.4 South Fork Coal Creek: Siltation

South Fork Coal Creek flows approximately 9 miles from its headwaters to its confluence with Coal Creek, encompassing an area of 18.5 square miles. Aquatic life and cold-water fishery beneficial uses were listed as impaired on the 1996 303(d) list. Other habitat alterations and siltation were the listed causes of impairment. The same causes appeared on the 2002 303(d) list, as well as riparian degradation. According to MDEQ's Data Assessment Record Sheet, the basis for the 2002 303(d) listing includes declining bull trout densities between 1989 and 1998, habitat alteration and bank erosion associated with historical logging activities, and observed substrate fines greater than 35 percent in 2 of 10 McNeil core samples (Phillips, 2000).

It appears that siltation is not currently impairing beneficial uses in the South Fork Coal Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the percentage of surface fines at three different sites. There was no indication of sediment

impairment in the macroinvertebrate data—the number of clinger taxa was high (more than 14). Because none of the targets were exceeded, beneficial uses in the South Fork Coal Creek are not considered impaired by sediment or siltation.

South Fork Coal Creek

The supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present with no indication of impairment by any pollutants (a high IBI score). The available fisheries data suggest that the bull trout population declined in the mid 1990s and then showed an improving trend starting in 1998. Although the suspended sediment concentration and turbidity data are old, they do not suggest water quality impairment due to siltation. Surveys found that there are several road and road-stream crossings potentially contributing sediment to the stream; however, there is no evidence of stream impairment by these minor sources. Clear-cut land is most likely not a major source of sediment because only a small percentage of the watershed has historically been clear-cut, and none since 1991. The ECA and water yield supplemental indicators suggest no impairment from harvested areas.

### 3.3.5 North Fork Coal Creek: Siltation

North Fork Coal Creek

The North Fork Coal Creek watershed covers approximately 23.2 square miles (14,895 acres), all of which is in the FNF. The creek was listed on the 1996 303(d) list as impaired by siltation and nutrients. The basis for the 1996 listing is unknown. Cold-water fishery and aquatic life beneficial uses were listed on the 2002 303(d) list as impaired by siltation. Nutrients were not listed as a cause of impairment on the 2002 303(d) list. According to MDEQ's Data Assessment Record, a significant decline in bull trout since 1990, along with indications of sedimentation problems in the watershed, is the primary basis for the 2002 303(d) listing (Suplee, 1999a).

Overall, it appears that siltation is not currently impairing beneficial uses in the North Fork Coal Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the percentage of surface fines at two different sites. There is no indication of sediment impairment in the macroinvertebrate data: the number of clinger taxa was high (greater than 14). Because none of the targets were exceeded, beneficial uses in the North Fork Coal Creek are not considered impaired by sediment or siltation.

Supplemental indicators generally supported this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present at the upstream site and there is no indication of impairment by any pollutants (high IBI score). Westslope cutthroat trout densities appear to be increasing over the period of record, and turbidity and suspended sediment concentrations historically do not suggest sediment impairments. Pfankuch surveys found good physical stream conditions, and road density, ECA, and water yield were low (good). Although data indicate that bull trout populations are declining in North Fork Coal Creek, the cause of the decline is unknown, and the cause of impairment does not appear to be similarly affecting the westslope cutthroat trout population. Some potential road sources of sediment were identified in the watershed; however, they do not appear to have had an effect on beneficial uses.

### 3.3.6 North Fork Coal Creek: Nutrients

As stated previously, the North Fork Coal Creek also appeared on the 1996 303(d) list for nutrients. However, it does not appear that nutrients are currently impairing beneficial uses in the creek. Macroinvertebrate data indicate that excellent aquatic life communities are present (high IBI score) with no indication of nutrient impairment (low HBI score). Also, westslope cutthroat trout densities are high and increasing, and suggest that no water quality impairments are present. None of the recent biological data indicate impairments of any kind in the North Fork Coal Creek. Also, there are virtually no anthropogenic sources of nutrients in the watershed (such as wastewater treatment, agriculture, fertilizers). The ECA and water yield for the watershed are low, and suggest that fires and clear-cutting have not impaired the creek's beneficial uses.

The overall lack of sources, combined with the excellent recent data on macroinvertebrate communities, suggests that the North Fork Coal Creek is not impaired by nutrients. However, additional data are necessary to verify this conclusion (see Section 5.0).

### 3.3.7 Lower Coal Creek: Siltation

Coal Creek flows 18 miles from its headwaters to its mouth, and the total watershed area covers approximately 82 square miles. Primary tributaries include South Fork Coal Creek, North Fork Coal Creek, Deadhorse Creek, and Cyclone Creek. The reach downstream of the confluence with the North and South Forks is referred to as "Lower Coal Creek." Most of Lower Coal Creek flows through the Coal Creek State Forest.

**Lower Coal Creek**

Cold-water fishery and aquatic life beneficial uses in Lower Coal Creek were listed on both the 1996 and 2002 303(d) lists as impaired by siltation. No information is available regarding the basis for the 1996 listing of Lower Coal Creek. The primary bases for the 2002 303(d) listing, according to MDEQ's Data Assessment Record, are sedimentation, embeddedness, bank erosion, and logging activities (Suplee, 1999b).

The approach for the Flathead River Headwaters TPA is to evaluate a suite of targets and supplemental indicators to make beneficial use determinations. When one or more of the targets are exceeded, the circumstances around the exceedance are investigated, and the supplemental indicators are used to

provide additional information to support a determination of impairment or nonimpairment. In the lower segment of Coal Creek, three out of the four targets were exceeded (McNeil cores, substrate scores, and percentage of surface fines).

When examined in the absence of the supplemental indicators, or without examining all of the available evidence, the targets in Lower Coal Creek clearly suggest water quality impairment associated with fine sediment. The McNeil core, substrate score, and percentage of surface fines all suggest impairment associated with fine sediment. Bull trout densities and redd counts have declined substantially in Lower Coal Creek, and have not rebounded in recent years as they have in the other North Fork Flathead Basin tributaries.

However, more than 20 years of McNeil core and substrate score data are available for Lower Coal Creek, and no trends are apparent over that period. Bull trout redd counts and densities from 1980 to 1991 show that high bull trout densities existed with historical McNeil core values as high as 42.1 and substrate scores as low as 9.6. The information suggests that that bull trout populations historically were not affected by high amounts of fine sediment (>35 percent McNeil core), and it does not appear that the substrate condition caused the observed decline in bull trout.

While it is possible that substrate conditions are currently preventing the bull trout population in Lower Coal Creek from rebounding, examination of the available data does not provide a black-and-white answer. The percentage of surface fines and macroinvertebrate data, for example, provide additional information that suggests that fine sediments are not causing impairment in Lower Coal Creek. The proposed surface fines threshold value (20 percent), a conservative value that suggests beneficial uses might be threatened by sediment, is barely exceeded in Coal Creek. Macroinvertebrate data were collected at the same time as the surface fines data. The macroinvertebrate data show that excellent communities were present at both sites in Coal Creek and at the two sites in the North and South Forks. Also, out of all of the macroinvertebrate data collected in the Flathead River Headwaters TPA, the four best IBI scores were found in the Coal Creek watershed. Clinger taxa were high at all four sites in the Coal Creek watershed, and did not indicate any impairment because of siltation. These data support the conclusion that *aquatic life beneficial uses are not impaired by current sediment conditions* in Lower Coal Creek.

Bull trout populations have failed to rebound in Lower Coal Creek as they have in many of the other North Fork Flathead River tributaries. Although there is uncertainty over the cause, the cold-water fishery beneficial use is considered impaired. The fact that the substrate conditions are slightly less than optimal in comparison with the proposed threshold values may or may not be contributing to this impairment. Other factors such as temperature, physical habitat condition (for example, large woody debris, number of pools, barriers, stream temperature) or high loads of sediment delivered to the stream from natural sources such as eroding banks or the recent Moose Fire may be the cause. Or perhaps it is a combination of factors, including historical coarse sediment loading that has not moved through the system. Given this uncertainty, a TMDL focusing on addressing all known anthropogenic sediment sources has been prepared and is presented in Section 4.0, Total Maximum Daily Load. A plan for a future study to identify the cause(s) of the bull trout population decline has been prepared and is presented in Section 5.0, Monitoring and Restoration Strategy.

### 3.3.8 Challenge Creek: Siltation

Challenge Creek flows approximately 4.3 miles from its origin to its confluence with Granite Creek. The cold-water fishery and aquatic life beneficial uses in Challenge Creek were listed on the 1996 303(d) list as impaired because of habitat alteration and siltation. The basis for the 1996 listing is unknown. In 2002, MDEQ indicated that the creek was "fully supporting" its beneficial uses and removed it from the 303(d) list. Additional information about Challenge Creek is available from the Montana MDEQ 303(d) Web site at http://nris.state.mt.us/wis/environet/2002_303dhome.html.

### 3.3.9 Granite Creek: Siltation/Suspended Solids

Granite Creek flows approximately 8.2 miles from its origin at the confluence of Dodge Creek and Challenge Creek to its confluence with the Middle Fork Flathead River. The total watershed area is 18,339 acres (28.7 square miles), one-third of which is in the Great Bear Wilderness Area. Because of the Wilderness Area, sampling efforts have focused on the upstream portion of Granite Creek located in the FNF. It is assumed that there are few or no anthropogenic sources of siltation and suspended solids in the Wilderness Area. According to field observations, portions of Granite Creek are intermittent in the headwaters region (Laidlaw, 2003).

Granite Creek was listed on the 1996 303(d) list as impaired because of habitat alteration, siltation, and suspended solids. Bank erosion, other habitat alterations, fish habitat degradation, and siltation were the causes of impairment listed on the 2002 303(d) list. The impaired beneficial uses were aquatic life and fisheries.

It appears that siltation and suspended solids are not currently impairing beneficial uses in Granite Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the surface fines data. There is no indication of sediment impairment in the macroinvertebrate data— the number of clinger taxa was high (greater than 14). Because none of the targets were exceeded, it can be concluded that beneficial uses in Granite Creek are not impaired by sediment or siltation.

**Granite Creek**

The supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present and there was no indication of impairment by any pollutants (high IBI score). The available fisheries data suggest that the bull trout population, after declining in the 1990s, is now rebounding. The cause of the decline is unknown, but it coincides with the documented changes in the bull trout fishery connected to Flathead Lake. ECA (15 percent) was less than the proposed indicator and the road density was low. Twelve percent of the watershed burned in 1998, and that fact likely has contributed increased natural sediment and water yield to the system. However, any effects from the fire do not appear to be impairing beneficial uses.

### 3.3.10 Skyland Creek: Siltation/Suspended Solids

Skyland Creek flows approximately 5.5 miles from its origin to its confluence with Bear Creek. It is a small, high-altitude stream that historically has not been managed as a bull trout fishery. The total watershed area is 5,343 acres (8.3 square miles), all of which is in the FNF. In 1998, 75 percent of the watershed burned, and most data collected since then reflect the impacts of the large burned area.

The cold-water fishery and aquatic life beneficial uses in Skyland Creek were listed on the 1996 303(d) list as impaired as a result of habitat alteration, suspended solids, and siltation. The basis for the 1996 listing is unknown. MDEQ lacked sufficient credible data to include this water body on the 2002 303(d) list. As a result, reassessment sampling was completed for Skyland Creek in August 2002.

**Skyland Creek**

It appears that siltation and suspended solids are not impairing beneficial uses in Skyland Creek. No siltation was evident in the surface fines data. Although the number of clinger taxa was slightly lower than the target value, Bollman (2003) noted that taxa richness was good and did not indicate a sediment impairment. Information for the other targets (McNeil cores and substrate scores) was not available.

Supplemental indicators generally suggest good conditions relative to sediment and siltation. The periphyton siltation index was low, which indicates that the algae community is not impacted by excessive sediment. Bollman (2003) reported that the macroinvertebrate community was "excellent" and that Skyland Creek had "unpolluted water" with no indication of sediment deposition. IBI scores, clinger taxa, and EPT taxa were all slightly lower than the recommended values. However, the cause may simply be watershed conditions (high elevation, low flow, drought) or the effects of the 1998 fire (increased water yield, increased sediment loads, increased nutrient loads; watershed disturbance). This theory is supported by the periphyton data, which suggested that excessive nutrient loading is present, most likely due to the 1998 fire.

Because of the 1998 Challenge fire, it is difficult to differentiate fire-related sediment impairments from impairments associated with other potential anthropogenic sources. The FNF and MDEQ inventoried anthropogenic sediment sources in 2002 and 2003, and found no major sources. Historically, a small percentage of the watershed has been clear-cut, but no land in the watershed has been clear-cut for the past 18 years. Full best management practices have been implemented on all roads, and the Forest Service found no indication of failing road-stream crossings. The lack of sources in the Skyland Creek watershed suggests that any impacts found in the stream are due to natural sources. This, in combination with the good percentage of surface fines, clinger richness, Pfankuch ratings, and low periphyton siltation index, indicates that Skyland Creek is not impaired by siltation or sediment.

However, the macroinvertebrate and periphyton data do suggest that a slight aquatic life impairment is present, most likely due to nutrients. This is explained and somewhat expected because of the 1998 fire and subsequent increased nutrient loading. The impairment is most likely due to natural sources (fire) and not anthropogenic sediment loading.

### 3.3.11 Morrison Creek: Siltation

Morrison Creek flows approximately 14.8 miles from its origin to its confluence with the Middle Fork of the Flathead River. The total watershed area is 32,324 acres (50.5 square miles), the lower half of which is in the Great Bear Wilderness Area. All of the land in the watershed is federally owned. Because of access constraints and the lack of potential anthropogenic sources in the Wilderness Area, sampling efforts have focused on Morrison Creek upstream of its confluence with Lodgepole Creek in the FNF.

The cold-water fishery and aquatic life beneficial uses in Morrison Creek were listed on both the 1996 and 2002 303(d) lists as impaired because of habitat alteration and siltation. The basis for the 1996 listing is unknown. The primary basis for the 2002 listing, according to MDEQ's Assessment Record Sheet, are the results of a 1989 MDEQ stream assessment (MDEQ, 2002).

**Morrison Creek**

It appears that siltation is not currently impairing beneficial uses in Morrison Creek. Pebble count and substrate scores indicate good substrate conditions with no signs of siltation. There were a high number of clinger taxa in the macroinvertebrate sample, and sediment does not appear to be impairing that community. Only one McNeil core sample was collected in 1990, and it was not considered in this analysis given the fact that it is only a single value and is 14 years old.

Other supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present and there is no indication of impairment from any pollutants (high IBI score). There is no indication that anthropogenic sources are contributing sediment to Morrison Creek. There have been no recent fires, harvests, or major road activity. The ECA was only 0.49 percent, roads are managed using best management practices, and no failing road-stream crossings were found. More than half of the watershed is part of the Great Bear Wilderness Area (a roadless, non-harvested area). Although bull trout populations have declined from 1980s levels, this trend is similar to the trend in other streams in the North Fork and Middle Fork Flathead River watersheds, and is potentially due to changes in the Flathead Lake and Flathead River ecosystem. Together, the collected data and lack of sources suggest that aquatic life and fishery beneficial uses are not impaired by sediment in Morrison Creek.

### 3.3.12 Hungry Horse Reservoir

The cold-water fishery and aquatic life beneficial uses in the Hungry Horse Reservoir were listed on the 1996 303(d) list as impaired because of flow alteration, siltation, and suspended solids. In 2000, MDEQ found the Hungry Horse Reservoir to be fully supporting its beneficial uses based primarily on the results of a 1999 MFWP study. Since it has been demonstrated that the Hungry Horse Reservoir is fully supporting its beneficial uses, no TMDL is necessary. As a result, Hungry Horse Reservoir is not discussed further in this report.

### 3.3.13 South Fork Flathead River

The South Fork Flathead River was listed on the 1996 303(d) list for water quality impairments associated with habitat and flow alteration, and for flow alteration on the 2002 303(d) list. Since no pollutants are cited as probable causes of impairment on either the 1996 or 2002 303(d) list, no TMDLs are necessary. As a result, the South Fork Flathead River is not discussed further in this report.

### 3.3.14 Sullivan Creek: Siltation

Sullivan Creek flows approximately 15.3 miles from its origin to its confluence with the Hungry Horse Reservoir. The watershed and its tributaries (including Quintonkon, Connor, Slide, Branch, and Ball Creeks) encompass 73 square miles.

The cold-water fishery and aquatic life beneficial uses in Sullivan Creek were listed on the 1996 303(d) list as impaired because of habitat alterations. MDEQ lacked sufficient credible data to include this water body on the 2002 303(d) list. The basis for the 1996 listing is unknown. As a result, reassessment sampling was completed for Sullivan Creek in August 2002.

**Sullivan Creek**

It appears that siltation is not currently impairing beneficial uses in Sullivan Creek. No siltation was evident in the pebble counts, and the number of clinger taxa was higher than the target at two sites. Information for the other targets (McNeil cores and substrate scores) was not available.

Supplemental indicators generally suggest good conditions in Sullivan Creek as well. Bull trout redd counts fluctuated over a 10-year period of sampling, but showed no apparent trends. The periphyton siltation index was very low (good) at two sites. Suspended sediment concentrations and turbidity values, although old, were low and similar to reference conditions.

Clear-cut land is most likely not a major source of sediment because only a small percentage of the watershed has historically been clear-cut, and very little has been clear-cut since 1984. At the upstream site, macroinvertebrate data indicate that aquatic life uses may be slightly impaired. However, Bollman (2003) noted that the data did not suggest that sediment was the cause of the impairment, and that "clean, cool water" was most likely present at the time of sampling. The Mountain IBI indicated full support at the downstream site. Good or excellent conditions were noted in the Pfankuch data at the upstream site, although not the downstream site. The fair ratings at the downstream site are thought to be due to natural conditions. A recent riparian survey found excellent conditions in Sullivan Creek. Overall, the aquatic life and fishery beneficial uses do not appear to be impaired because of sediment in Sullivan Creek.

## 3.4 Water Quality Impairment Status Summary

The previous sections summarized the results of the beneficial use analyses conducted in the Flathead River Headwaters TPA. The weight-of-evidence approach described in Section 3.2 was applied to the listed water bodies to verify beneficial use impairments. Using this approach, aquatic life and fishery beneficial use determinations were updated for each water body. A summary is presented in Table 4. The South Fork Flathead River, Hungry Horse Reservoir, Big Creek, and Challenge Creek have been addressed in other TMDLs or through MDEQ's 303(d) reassessment process and were therefore not considered in this analysis.

As shown in Table 4, none of the evaluated stream segments except Lower Coal Creek are impaired as a result of excessive levels of fine sediment. In Lower Coal Creek, the cold-water fishery beneficial use is currently considered impaired, and a sediment TMDL will be developed (see Section 4.0). Although it does not appear that nutrients are impairing beneficial uses in North Fork Coal Creek, insufficient data are available at this time to make a final determination.

**Table 4. Current Water Quality Impairment Status for the Flathead River Headwaters TPA**

| Water Body Name and Number | Year Listed | Listed Probable Causes | Current Impairment Status | Proposed Action |
|---|---|---|---|---|
| Red Meadow Creek MT76Q002-020 | 1996 | Habitat alterations/siltation | Not impaired | ▪ Implement Water Quality Improvement Strategy to address identified sources.<br>▪ Conduct follow-up McNeil core monitoring. |
| | 2002 | Habitat alterations/siltation | | |
| Whale Creek MT76Q002-030 | 1996 | Habitat alterations/siltation | Not impaired | ▪ Implement Water Quality Improvement Strategy to address identified sources. |
| | 2002 | Habitat alterations/siltation | | |
| South Fork Coal Creek MT76Q002-040 | 1996 | Habitat alterations/siltation | Not impaired | ▪ Implement TMDL to address identified sources and habitat alterations.<br>▪ Conduct habitat and source assessment to address uncertainties<br>▪ Conduct follow-up nutrient monitoring in North Fork Coal Creek. |
| | 2002 | Habitat alterations/siltation | | |
| Lower Coal Creek, SF to confluence with NF River MT76Q002-080 | 1996 | Siltation | Impaired for habitat alterations and sediment | |
| | 2002 | Siltation | | |
| North Fork Coal Creek MT76Q002-070 | 1996 | Nutrients/siltation | Not impaired for siltation. Unknown for nutrients. | |
| | 2002 | Siltation | | |
| Granite Creek MT76I002-010 | 1996 | Habitat alterations/ Siltation/suspended solids | Not impaired | ▪ No action |
| | 2002 | Siltation/bank erosion | | |
| Skyland Creek MT76I002-020 | 1996 | Habitat alterations/ siltation/suspended solids | Not impaired | ▪ No action |
| | 2002 | Insufficient credible data | | |
| Morrison Creek MT76I002-050 | 1996 | Habitat alterations/siltation | Not impaired | ▪ No action |
| | 2002 | Habitat alterations/siltation | | |
| Challenge Creek MT76I002-040 | 1996 | Habitat alteration/siltation | Not impaired | ▪ No action |
| | 2002 | Not listed | | |
| South Fork Flathead River MT76J001-010 | 1996 | Habitat alterations<br>Flow alterations | Flow alteration | ▪ No action |
| | 2002 | Flow alterations | | |
| Sullivan Creek MT76J003-010 | 1996 | Habitat alterations | Not impaired | ▪ Implement Water Quality Improvement Strategy to address identified sources.<br>▪ Conduct follow-up McNeil core monitoring. |
| | 2002 | Insufficient credible data | | |
| Hungry Horse Reservoir MT76J002-1 | 1996 | Flow alteration<br>Siltation<br>Suspended solids | Not Impaired | ▪ No action |

# 4.0 Total Maximum Daily Load (TMDL)

This section presents all of the required TMDL elements for Coal Creek, the only water body within the TPA that is currently considered impaired. This TMDL applies to the entire Coal Creek watershed.

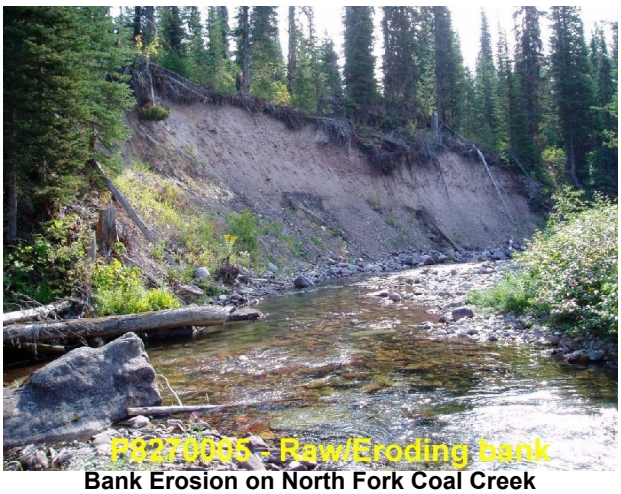
## 4.1 Sources of Sediment

Potentially significant natural and anthropogenic sources of sediment loading to streams in the Flathead River Headwaters TPA include fire, timber harvest activities, the forest road network including stream crossings, bank erosion, mass wasting from avalanche chutes, natural soil creep, and stream down-cutting. These potential sources of sediment are discussed below for Coal Creek, which is the only water body with impaired beneficial uses (See Sections 3.3.4–3.3.7).

**Stream Eroding the Road Prism on Road 5278 in the Coal Creek Watershed**

The FNF and MFWP conducted the most recent and comprehensive source assessments in the Coal Creek watershed, looking at in-stream sediment conditions and potential upland sources of sediment. According to the FNF survey, a total of 10 road sites deliver 1,000 pounds of sediment to the stream network each year. Examples of road sediment sources observed during the survey were plugged culverts at risk of failure, sediment slumps, and active streams eroding the road prism.

Bank erosion is a natural process in streams, and can contribute a significant natural load of sediment. However, anthropogenic sources—such as grazing, roads, riparian harvests, or flow modifications—can lead to increased bank erosion. MFWP identified areas with significant bank erosion during the 2002–2003 survey of the Coal Creek watershed. Most of the bank erosion noted during the survey appears to be natural, although at one site (Site ID 1), bank erosion was due to an old road culvert that was improperly removed. It is estimated that approximately 700 tons of sediment are delivered to the stream network due to bank erosion per year. Approximately 0.1 ton per year appears to be attributable to human activity. The remainder is thought to be largely a natural phenomenon.




**Bank Erosion on North Fork Coal Creek**

Fire can contribute to increased erosion because of increased surface water runoff and the removal of vegetation, forest litter, and root masses. In 2001, the Moose Fire burned 14,938 acres (30 percent) of the Lower Coal Creek watershed. The FNF modeled the effects of the fire using the Water Erosion Prediction Model (WEPP) and estimated a sediment load of 53,000 tons for 2003, or an average of 3.55 tons of sediment per acre per year. However, the WEPP model assumed that average rainfall fell in the Coal Creek watershed in 2002 and 2003. Since both 2002 and 2003 were extremely dry years

sediment loads from the Moose Fire are most likely much less than estimated. Forest service personnel estimated that less than 1 ton of sediment per acre of land was actually delivered to streams in 2003, or approximately 10,000 total tons of sediment (Sirucek, personal communication, September 20, 2004). The amount of erosion due to the Moose Fire will continue to decrease in the future as the forest revegetates, and soils and water yield stabilize.

Harvest activities can also contribute to increased erosion because of increased water yields, ground disturbances, and removal of binding vegetation. Since 1960, 18 percent of the Coal Creek watershed has been harvested (9 percent intensive harvests), with 1 percent harvested since 1995. The WEPP model estimated that harvest activities contributed 34 tons of sediment per year, as calculated in 2003. This load will continue to decrease in the future as the forest revegetates and water yields decrease.

**Effects of the Moose Fire in Coal Creek and Vegetative Regrowth Since 2001**

**Clear-cut Land in the Coal Creek Watershed (Year 2000)**

## 4.2 Coal Creek Sediment Targets and TMDL

A TMDL is composed of the sum of individual waste load allocations from point sources (any single identifiable source of pollution, such as a pipe, ditch, or factory) and load allocations from nonpoint sources of pollution (diffuse sources, such as agriculture, forestry, mining, construction, or dams) and natural background levels. There are no point sources of sediment in the Coal Creek watershed. Also, humans have no control over natural sediment loading from eroding banks, fire, and avalanche chutes. Therefore, wasteload allocations and natural loadings are not included in the Coal Creek TMDL, and the TMDL is expressed merely as the sum of the allocations to the known anthropogenic nonpoint sources. However, given that the estimated loads from anthropogenic sources are very small in comparison with the estimated loads from natural sources, it is not known whether reducing anthropogenic sources will result in significant improvements to the bull trout fishery. Given the uncertainty of the link between current anthropogenic sediment loading and the current health of the bull trout population in Coal Creek, an unconventional "Phase II" allocation is also proposed. The purpose of the Phase II allocation is to facilitate future study to (1) ensure that all of the anthropogenic sources are appropriately addressed, and (2) better understand the non-pollutant issues that may be having an impact on bull trout (for example, large woody debris, physical habitat issues, channel morphology, barriers). The TMDL and allocations are further summarized in Table 5 and are described in more detail in Section 4.0 of the full report.

MDEQ is required to assess the waters for which TMDLs have been completed to determine whether compliance with water quality standards has been attained. This is done using a series of targets (or goals) against which compliance with water quality standards will be measured in Lower Coal Creek (Table 6). If all the target threshold values are met, it will be assumed that beneficial uses are fully supported and water quality standards have been achieved. Alternatively, if one or more of the target threshold values are exceeded, it will be assumed that beneficial uses are not fully supported and water quality standards have not been achieved. However, it will not be automatically assumed that implementation of this TMDL was unsuccessful just because one or more of the target threshold values have been exceeded. The circumstances around the exceedance will be investigated, and recommendations will be made based on the findings.

**Table 5. Sediment Load Allocations for Coal Creek**

| Sources | Current Load (tons/year) | | Reduction | Allocation (tons/year) or Approach |
|---|---|---|---|---|
| **Point Sources (wasteload allocations)** | 0 | | Not applicable | 0 |
| **Anthropogenic Nonpoint Sources (load allocations)** | **Existing Roads** | 0.5 | 75%<br>0.375 ton/year | 0.125 |
| | **Historical/Current Harvest** | 34 | 100%<br>34 tons/year | 0 |
| | **Bank Erosion** | 0.1 | 90%<br>0.09 ton/year | 0.01 |
| | **Other**[a] | Unknown | To be determined | To be determined |
| | **Future Roads and Harvest** | Not specified | Not specified | No sediment loading increases other than potential minor predicted short-term increases associated with 100% compliance with applicable best management practice standards. |
| **Phase II – Uncertainty and Non-Pollutant Issues** | To be determined | | To be determined | To be determined |

[a]See "Water Quality Assessment and TMDLs for the Flathead River Headwaters Planning Area, Montana" for a definition of "other."

**Table 6. Coal Creek Water Quality Goals**

| Water Quality Goal | Threshold |
|---|---|
| 5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm | 35% |
| 5-year Mean Substrate Score | ≥ 10 |
| Percentage of Surface Fines < 2 mm | < 20% |
| Clinger Richness | ≥ 14 |

# 5.0 Monitoring and Restoration Strategy

Additional monitoring is proposed for Coal Creek to (1) monitor the implementation of the Coal Creek TMDL, (2) confirm that all significant sources of siltation and suspended solids have been identified, (3) assess channel morphology and in-stream sediment concerns, and (4) address nutrient data gaps for North Fork Coal Creek. Furthermore, additional monitoring is recommended for other streams in the Flathead River Headwaters TPA to address unknown sources and data gaps. The proposed monitoring is explained in more detail in Sections 5.0 and 6.0 of the full report.

To restore beneficial uses in Coal Creek, a two-phased restoration strategy is proposed. In phase I, the unknown cause of impairment will be addressed with additional monitoring and field surveys. Once additional data are collected, a Phase II strategy will be developed to address the findings. It is envisioned that implementation of Phases I and II will be a joint effort among MFWP, the FNF, the Flathead Basin Commission, and Montana Department of Natural Resources and Conservation with some assistance from MDEQ and EPA. The Flathead Basin Commission has applied for a grant under Section 319 of the Clean Water Act to MDEQ to implement this strategy.

A restoration strategy is also proposed to address the sources of sediment identified in the Red Meadow Creek, Sullivan Creek, and Whale Creek watersheds. Roads are the primary anthropogenic sources of sediment in need of mitigation in the watersheds. Approximately 9, 21, and 33 miles of roads in the watersheds of Red Meadow Creek, Whale Creek, and Sullivan Creek, respectively, need further evaluation to identify specific source areas and restoration strategies. In addition, a number of issues regarding culverts and stream crossings need further evaluation to develop specific restoration strategies. Because all of the identified source areas in these watersheds are on lands managed by the FNF, the FNF will be responsible for the actual implementation of restoration measures.

# 6.0 Conclusions

It has been determined that the cold-water fishery and aquatic life beneficial uses in Red Meadow Creek, Whale Creek, South Fork Coal Creek, North Fork Coal Creek, Granite Creek, Skyland Creek, and Morrison Creek are currently fully supported. These waters are not considered impaired due to siltation or suspended solids; therefore, no TMDLs are required. However, minor man-caused sediment sources were identified in Red Meadow, Whale, and Sullivan Creeks. A Voluntary Water Quality Improvement Strategy is proposed to improve the overall watershed health in these three streams.

Other 303(d)-listed segments in the Flathead River Headwaters TPA are not addressed in this report for a variety of reasons. Some were found to be fully supporting beneficial uses on the 2002 303(d) list (Challenge Creek and Hungry Horse Reservoir). Big Creek, a tributary to the North Fork Flathead River, was addressed in a separate TMDL analysis in 2003 (approved on May 9, 2003). The South Fork Flathead River was never listed for any pollutants, only flow and habitat alterations. Therefore, no TMDLs are required for this segment.

The available data for the North Fork Coal Creek suggest that nutrients are not impairing beneficial uses. However, there is still some uncertainty in this analysis because the data are limited. Additional water quality data have been collected to address the uncertainties, and data will be evaluated to make a final determination. If it is found that anthropogenic sources of nutrients are not causing an impairment, documentation will be provided to the MDEQ to allow for the 303(d) list status of this water body to be changed in 2006 (the next 303(d) list to be prepared by MDEQ). If, on the other hand, it is determined that anthropogenic sources of nutrients are causing impairment, a TMDL for nutrients will be prepared.

Unlike many of the other North Fork Flathead River tributaries, bull trout populations have failed to rebound in Lower Coal Creek. The cause of this impairment is unknown. The fact that the substrate conditions are slightly less than optimal (in comparison with proposed target values) may or may not be contributing to this impairment. Other factors such as physical habitat condition (for example, large woody debris, number of pools, barriers, stream temperature, etc.) or high loads of sediment delivered to the stream from natural sources such as eroding banks or the recent Moose Fire may be the cause. Or, perhaps, it is a combination of factors. Given the uncertainty, a TMDL is proposed, and focuses on addressing all known human-caused sediment sources. Further study is also suggested to identify the cause(s) of the bull trout population decline (see Section 5.0).

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